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## D3060/F1050 INSTRUMENTATION AND CONTROL (I&C)



### RECORD OF REVISIONS

| Rev | Date | Description | POC | OIC |
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# D3060/F1050 INSTRUMENTATION AND CONTROL (I&C)

## 1.0 APPLICATION OF THIS CHAPTER

### 1.1 General

A. The purpose of this chapter of the LANL Engineering Manual (LEM) is to ensure I&C systems are designed to prevent accidents and mitigate consequences; are efficient, convenient, and adequate for good service; and are maintainable, standardized, and adequate for future expansion.

B. All **facility**-related I&C design, material, equipment, and installations shall comply with site-specific requirements in this Chapter and Chapter 1 of the LEM.[1] Requirements in this Chapter that also apply to **programmatic** work are addressed in Section 1.3.

C. When new requirements are issued in the LEM, use the following to determine if the new revision is applicable to projects already started. For **small construction projects (programmatic or facility),** the point used to determine applicability of new requirements is the FM's or Division Leader's approval to proceed with final design (beyond which, it is not necessary to apply the new requirements). Final design includes preparation of final working drawings, specifications, bidding documents, cost estimates, and coordination with all parties that might affect the project; development of firm construction and procurement schedules; and assistance in analyzing proposals or bids (from DOE O 4700.1). For **major projects** under the requirements of LIR 220-01-01, Construction Project Management, refer to LIR 220-03-01, LANL Engineering Manual (Projects Underway), for application of the LEM.

D. Where appropriate, guidance is provided to aid the cost-effective implementation of site-specific requirements and the requirements in the applicable codes. *Italicized* text identifies recommended guidance (not mandatory), based on good business practice and through lessons-learned at LANL. All other text in regular type indicates **mandatory** requirements unless prefaced with wording identifying it as guidance or a recommendation.

E. In addition to new I&C installations, this chapter applies to some renovation, replacement, modification, maintenance, or rehabilitation projects.

1. Bring existing I&C systems into compliance with current codes and requirements in this chapter when renovation work includes major replacements, modifications, or rehabilitation that exceeds 50% of the estimated replacement value[2] of the existing I&C system or subsystem[3], and consider upgrading whenever work is initiated to address a safety issue or when safety related systems will be effected by the modifications.

    a. This requirement applies on a system or subsystem basis (e.g., a discrete HVAC control, process control, alarm, interlock, or indication system).

    b. Systems and subsystems are listed in Section 210 of Chapter 1 of the LEM.

F. *Responsibility for the design of I&C, mechanical, and electrical systems can vary across organizations. Because this is a new chapter, the following table is included to show how LANL plans to distribute certain standards information between this and other LEM chapters. NOTE: Coordination between the discipline designers is essential to achieve the best systems.*

| ***Electrical*** | ***I&C*** | ***Mechanical*** |
|---|---|---|
| *All power and control wiring* | *Controllers and processors for real-time control of mechanical, lighting, or building energy system monitoring* | *Fluid controlling devices such as valves and dampers with the associated actuators* |
| *Power supplies and UPS systems* | *Sensors and transmitters (temperature, humidity, flow, pressure, orifice plates, thermowells, flow measuring arrays and stations, etc.)* | *Local mechanical (non loop) indicators such as gauges and thermometers* |
| *Power switches, breakers, and relays* | *Self-contained controllers such as thermostats and humidistats* | *Instrumentation tubing and isolation valves* |
| *Electrical protective relays and devices* | *Reference pressure devices* | *Instrument air delivery systems* |
| *Motors, motor starters, and variable frequency drives (VFDs)* | *Low voltages switches and relays used as output devices to control mechanical systems* | |
| *Current and potential transformers used for electric metering and protection functions* | *Current transformers and relays used for status monitoring* | |
| *Electrical distribution monitoring and control* | | |

## 1.2 Exclusions

A. The following are excluded from the requirements of this chapter.

1. Fire Protection systems and devices are covered by Chapters 2 and 7 of the LEM.
2. Systems and devices providing security functions and controlled by S-Division.
3. Systems and devices that have the primary purpose of controlling vehicular and/or pedestrian traffic.

## 1.3 Programmatic[4]

A. The I&C Chapter shall be applied to programmatic systems and components as follows:

1. Headings in this chapter followed by “Programmatic and Facility” or a bold “P&F” indicate that subsection shall be complied with by all of LANL, including programs.
2. *Guidance: Programmatic personnel should review all topics in the chapter for relevant material when initiating any design task.*

## 2.0 ACRONYMS AND DEFINITIONS

| | |
|---|---|
| **AHJ** | Authority having jurisdiction. |
| **Design Agency** | The organization performing the detailed design and analysis of a project or modification. |
| **Design Authority** | The person or group responsible for the final acceptability of and changes to the design of a system or component and its technical baseline (typically the manager of engineering). |
| **Facility** | A synonym for Real Property and Installed Equipment. RP&IE is the land, improvements on the land such as buildings, roads, fences, bridges, and utility systems and the equipment installed as part of the basic building construction that is essential to normal functioning of a building space, such as plumbing, electrical and mechanical systems. This property/equipment is also referred to as institutional or plant and was formerly known as Class A. [DOE Order 4330.4B]. |
| **LCSM** | LANL Construction Specification Manual. |
| **LEM** | LANL Engineering Manual. |
| **LIG** | Laboratory Implementation Guidance. |
| **LIR** | Laboratory Implementation Requirements. |
| **Major Project** | Construction project greater than $500k (CPM LIR 220-01-01). |
| **ML-1** | Management Level 1 (ML1) - Rigorous application of applicable codes, standards, procedural controls, verification activities, documentation requirements, and formalized maintenance program. Could include facility work for which independent review and management approvals for such things as design verification, procurement, fabrication, installation, assembly, and construction are considered essential. See LIG 230-01-02, Graded Approach for Facility Work. |
| **ML-2** | Management Level 2 (ML2) - Selective application of applicable codes, standards, procedural controls, verification activities, documentation requirements, and formalized maintenance program (i.e., certain elements may require extensive controls, while others may only require limited control measures). Could include facility work that may require independent review, management approval, and verification of design outputs, surveillance during procurement, fabrication, installation, assembly, and construction. See LIG 230-01-02, Graded Approach for Facility Work. |
| **ML-3** | Management Level 3 (ML3) - Application of appropriate codes, standards, procedural controls, verification activities, and documentation requirements that are consistent with recognized industry practices. Could include facility work that is normally manufactured, installed, assembled, and/or constructed in accordance with recognized codes and standards. See LIG 230-01-02, Graded Approach for Facility Work. |

| | |
|---|---|
| **POC** | Point of contact. For the LEM chapter/discipline Technical Committee POCs see http://www.lanl.gov/f6stds/pubf6stds/techcommittees.html |
| **Programmatic** | A synonym for Personal Property and Programmatic Equipment. PP&PE is equipment used purely for programmatic purposes, such as reactors, accelerator machinery, chemical processing lines, lasers, computers, machine tools, etc., and the support equipment dedicated to the programmatic purpose. This property/equipment is also referred to as organizational, research, production, operating or process and was formerly known as Class B. [DOE Order 4330.4B]. |
| **Safety Class (SC)** | Systems, structures, or components including primary environmental monitors and portions of process systems, whose failure could adversely affect the environment, or safety and health of the public as identified by safety analyses. [DOE 5480.30]. |
| **Safety-related** | A term meaning safety class, safety significant, and ML-1 and ML-2 systems; any of these could potentially impact worker or public safety or the environment if they failed. |
| **Safety Significant (SS)** | Structures, systems, and components not designated as safety-class SSCs but whose preventive or mitigative function is a major contributor to defense in depth (i.e., prevention of uncontrolled material releases) and/or worker safety as determined from hazard analysis.<br><br>As a general rule of thumb, safety-significant SSC designations based on worker safety are limited to those systems, structures, or components whose failure is estimated to result in an acute worker fatality or serious injuries to workers. Serious injuries, as used in this definition, refers to medical treatment for immediately life-threatening or permanently disabling injuries (e.g., loss of eye, loss of limb) from other than standard industrial hazards. It specifically excludes potential latent effects (e.g., potential carcinogenic effects of radiological exposure or uptake). (DOE-STD-3009 Chg. 1). |
| **Small Construction Project** | Construction project below $500k. |
| **WSS** | Work Smart Standards. A set of Orders and national codes and standards in Appendix G of the LANL UC Contract. |

## 3.0 CODES AND STANDARDS (PROGRAMMATIC AND FACILITY)

### 3.1 General

A. Comply with the applicable portions of the latest edition of each code and standard listed below, referenced elsewhere in this chapter, and others as applicable, unless otherwise specified in the LEM or WSS. LANL Work Smart Standards are denoted as "WSS."

B. The correct application of the LEM requirements is the responsibility of the designer/design agency. If the designer believes the LEM to be incorrect (e.g., compliance will cause a problem), it is his or her responsibility to bring the issue to the attention of the LEM Discipline POC (through the Project Manager if appropriate) for resolution.

C. The engineer/designer is responsible for a complete design package (drawings and specifications) as required to meet project specific requirements. Refer questions concerning the contents in the LANL Engineering Standards to the applicable LANL discipline POC. *Guidance: The LANL Standards are not intended to cover all design requirements and construction specifications necessary to provide a complete operating facility or system. The design organization is responsible for providing a complete design package.*

D. If there is a conflict between codes, standards, and LANL requirements such as this manual or project programming requirements such as Functional and Operational Requirements (F&OR), contact the LANL Engineering Manual (LEM) Discipline POC[5] for assistance in resolving the conflict. If a requirement in any LANL document exceeds a minimum code or standard requirement, it is not considered a conflict, but a difference, so comply with the most stringent requirements among the LANL documents.

E. Requested variances and exceptions to the LEM requirements shall be prepared and submitted to the I&C POC for initial review and approval prior to his forwarding to the LEM Standards Manager, LEM OIC, and initiating and FWO Division Leaders per LIR 301-00-02, Variances and Exceptions to Laboratory Operations Requirements, and LIR 220-03-01, LANL Engineering Manual.

F. Codes of Record: The codes and standards in effect when a facility design commences are considered the "codes of record" and often remain in effect for the life of the facility. Establishment and maintenance of the facility's design basis, including "codes of record" shall be in accordance with LIR 240-01-01, Facility Configuration Management. As determined by the Design Authority (System Engineer's management) and the LEM I&C POC, the codes of record can be applied to later modifications, replacements, or rehabilitation less than 50% of the estimated replacement value when justifiable (when greater than 50%, the system shall be upgraded to current standards).

G. Listed Equipment: All permanently installed programmatic I&C equipment and all ML-1, ML-2, and ML-3 facility I&C equipment shall be Nationally Recognized Testing Laboratory (NRTL) listed (e.g., UL, TUV, FM, etc.) or approved in accordance with LIR 402-600-01 (Electrical Safety) and shall only be used for the purpose in which it is intended in accordance with its listing or Electrical Safety Officer approval.[6] *Guidance: All other programmatic I&C installations should be Nationally Recognized Testing Laboratory (NRTL) listed equipment (e.g., UL, TUV, etc.) and should only be used for the purpose in which it is intended in accordance with its listing whenever possible. Guidance: Peer review of the system design is especially useful and highly recommended for prototype installations.*

H. Prototype or Temporary Installations: Prototype programmatic equipment or temporary (less than 90 days) facility or programmatic equipment must be installed in accordance with and meet the requirements of LIR 402-600-01 (Electrical Safety). *Guidance: Peer review of the system design is especially useful and highly recommended for prototype installations.*

I. Online Codes and Standards: Access to selected online national codes and standards are available to anyone with a LANL IP address or "smart card" at: http://lib-www.lanl.gov/infores/stand/stanihs.htm

J. LANL Work Smart Standards (WSS) (Programmatic and Facility) [7] http://labs.ucop.edu/internet/app_g/wss_lanl.pdf

K. Comply with the latest edition and addenda in effect on the effective date noted in the WSS set, unless otherwise specified. Exception: Comply with the latest edition of the CFRs including all other applicable CFRs not listed in the WSS set.

1. *Guidance: CFRs with significant I&C design impact include OSHA (29 CFR 1910), especially subparts G, H, and Z regarding ventilation. CFRs available at http://www.access.gpo.gov/nara/cfr/cfr-table-search.html*

## 3.2 LANL Engineering Standards

A. Engineering Manual (LEM), OST220-03-01-EM[8]

1. *Guidance: This chapter numbering generally follows the UNIFORMAT system promulgated by the Construction Specifications Institute (CSI) and further described in ASTM E1557.*

2. Comply with standard detail drawings in the LEM unless referenced in *italicized* text. Edit the details to reflect the particular details of the project. *Guidance: The first digit of the standard drawing number, e.g., ST8XXX, designates the manual chapter (8 = Chapter 8, I&C).*

B. Construction Specifications Manual, OST220-03-01-CSM [8] (Spec sections applicable to Programmatic work are clearly identified in that manual).

1. Comply with the LANL Construction Specifications Manual (LCSM) when writing and preparing a specification package, i.e., format, writing and editing, etc. *Guidance: The LCSM provides construction specifications that are referenced throughout the LEM. Specs are preferred over extensive drawing notes.*

2. Number the specification sections in accordance with the CSI Master Format document, but do not renumber LANL Master Specs. *Guidance: LANL Master Specifications that do not conform to CSI numbers are being revised.*

3. Comply with specifications in the LEM unless referenced in *italicized* text. When editing these specifications to suit the project, add job-specific requirements and delete only those portions that in no way apply. To seek a variance from applicable requirements, contact the LEM discipline POC.

C. Drafting Manual, OST220-03-01-DM [8]

1. Comply with the LANL Drafting Manual when creating or revising drawings for facility projects. *Guidance: This manual does not address weapons design work covered by ESA Division procedures.* ***Use of the LANL Drafting Manual is recommended for programmatic work.*** *The manual was completely revised in October 2001 and is periodically updated.*

*The above manuals are available at http://www.lanl.gov/f6stds/pubf6stds/xternhome.html*

### 3.3 DOE (Department of Energy) (Selected Orders)

*The following directives are available at http://www.directives.doe.gov/serieslist.html*

A. DOE O 420.1, Facility Safety, Attachment 2, Contractor Requirements Document (CRD) in its entirety with exceptions as noted below: (WSS) (Programmatic and Facility).

1. Section 4.2, 2nd Paragraph (4)
2. Section 4.2.1.9
3. Section 4.2.2.4
4. Section 4.3.2d(1)
5. Section 4.3.2d(2), 3rd Sentence

B. DOE G 420.1-1, Nonreactor Nuclear Safety Design Criteria and Explosive Safety Criteria Guide for use with DOE O 420.1 Facility Safety (Programmatic and Facility).

C. DOE M 440.1, Explosive Safety Manual (WSS) (Programmatic and Facility).

D. DOE O 6430.1A, General Design Criteria - Division 13, Special Facilities, only (WSS).

## 4.0 DESIGN DOCUMENTATION

### 4.1 General

A. Documentation shall include, but is not limited to, the following: (Programmatic and Facility).

1. Calculations: Note the source of each formula or method used, list all assumptions and exceptions, and define all units. Provide copies of tabulated data used. If a computer program was used, provide input file on CD.
2. Equipment Selection Criteria: Include flow rates, pressure or head requirements, operating temperatures, efficiency, energy consumption, and sound ratings. If manufacturer selection program is used, provide separate calculations showing altitude corrections for motor size is properly performed.
3. Include copies of catalog sheets showing equipment performance points for all major equipment included in the systems design.

B. Drawing content and format shall comply with the LANL Drafting Manual including its Mechanical section (*Section 305*) and Electrical section *(Section 306)*.

C. *Guidance: ISA instrument data sheets are available from FWO-SEM to assist in procurement of instrumentation*.

### 4.2 Sealing Construction Documents (Programmatic and Facility)

A. Comply with the New Mexico Engineering and Surveying Practice Act (Chapter 61, Article 23 NMSA 1978), http://www.state.nm.us/pepsboard/Act.htm. All plans, designs, drawings, specifications, or reports prepared for LANL by consultants or contractors that are involved in the practice of engineering shall bear the seal and signature of a professional engineer in responsible charge and directly responsible for the engineering work.

1. University employed engineers, performing engineering services involving the operation of LANL, on LANL property, are exempt from the licensing requirements of the New Mexico Engineering and Surveying Practice Act. [9]

## 5.0 ENERGY CONSERVATION/SUSTAINABLE DESIGN

A. Comply with ASHRAE Standard 90.1. This standard provides minimum energy-efficient requirements for the design and construction of new buildings and their systems, new portions of buildings and their systems, and new systems and equipment in existing buildings.

B. Provide a computerized Facility Management System in all new, air conditioned buildings larger than 10,000 square feet.[10]

C. HVAC control systems design, materials, and construction are an integral component of sustainable design. Design I&C systems and specify equipment for compatibility with the building and site aesthetics, lighting and electrical systems requirements, and indoor environmental quality requirements to ensure that multi-discipline whole-building sustainable design practices are followed.

1. *Guidance: Refer to the Green Building Council's LEED rating system and other resources at* http://www.usgbc.org/resource/index.htm *and DOE/GO-102001-1165, Greening Federal Facilities; An Energy, Environmental, and Economic Resource Guide for Federal Facility Managers and Designers.* http://www.nrel.gov/docs/fy01osti/29267.pdf

## 6.0 EQUIPMENT LOCATION

A. I&C equipment shall be accessible for inspection, service, repair, and replacement without removing permanent construction, as required by code and as recommended by the manufacturer.[11]

1. If equipment is not accessible with a man-lift or rolling platform, provide permanent OSHA compliant structures for access to equipment installed 12 feet or higher above finished floors, e.g., controllers, transmitters, valve/damper actuators, etc.

## 7.0 EQUIPMENT IDENTIFICATION

A. Identify major I&C equipment in accordance with the nomenclature indicated in LANL Engineering Manual, Chapter 1, Section 230, Component Nomenclature.

B. Label I&C equipment in accordance with LEM Chapter 1, Section 240, Labeling (future), LANL Construction Specification 15075, Mechanical Identification, and LANL Construction Specification 16195, Electrical Identification as applicable. [12]

## 8.0 GRADED APPROACH TO DESIGN STANDARDS[13] (PROGRAMMATIC AND FACILITY)

*A. Guidance: Consider the following standards when designing I&C systems:*

**Table 8-1**
**Recommended Standards for I&C Systems**

| Component/ Function | ML-3/ General Service | ML-2/ Safety Significant | ML-1/ Safety Class |
|---|---|---|---|
| General | ISA 5.1 and 5.3; IEEE N323; IEEE C2; NFPA 70 and 110; NFPA 79 | ISA series especially 5.1, 5.3, and 84.01[14]; NFPA 70 and 110; IEEE C2, N323, 141, 142, 242, 493, and 1050; DOE G 420.1-1; NFPA 79 | ISA series especially 5.1 and 5.3; NFPA 70 and 110; ANSI N320; IEEE C2, N323, 141, 142, 242, 323, 336, 338, 344, 379, 384, 493, and 1050; DOE G 420.1-1; NFPA 79 |
| Scaling | ISA 67.04 | ISA 67.04 | ISA 67.04 |
| Monitoring | HPS ASC N13; IEEE N42.18; NFPA 70; ANSI N13 series | HPS ASC N13; IEEE N42.18; NFPA 70; ANSI N13 series<br>ANS 8.3 (criticality only) | HPS ASC N13; IEEE N42.18; NFPA 70; ANSI N13 series<br>ANS 8.3 (criticality only) |
| Programmable Digital Equipment | IEEE 1046 and 1289; ANS 10.5 | IEEE 1046 and 1289; ANS 10.5; NUREG 0700 | IEEE 1046 and 1289; ANS 10.5; NUREG 0700 |
| Ventilation (Uniformat Section D3060) | ASHRAE 111 | ASHRAE 111, ASME AG-1 | ASHRAE 111, ASME AG-1 |

Standard titles appear below.

**Titles for Table 8-1**

**ANS 8.3**, Criticality Accident Alarm System

**ANS 10.5**, Accommodating User Needs in Computer Program Development

**ANSI N13** series addresses radiation monitoring equipment

**ANSI N320**, Performance Specifications for Reactor Emergency Radiological Monitoring Instrumentation

**ASHRAE 111**, Practices for Measurement, Testing, Adjusting, and Balancing of Building Heating, Ventilation, Air-Conditioning, and Refrigeration Systems

**ASME AG-1**, Code on Nuclear Air and Gas Treatment

**DOE G 420.1-1**, Nonreactor Nuclear Safety Design Criteria and Explosive Safety Criteria Guide for use with DOE O 420.1 Facility Safety

**HPS ASC N13**, Guide to Sampling Airborne Radioactive Materials in Nuclear Facilities [Health Physics Society Accredited Standards Committee]

**IEEE**

**C2**, National Electrical Safety Code [NESC]

**N323**, Radiation Protection Instrumentation Test and Calibration (ANSI/IEEE)

**N42.18**, Specification and Performance of On-Site Instrumentation for Continuously Monitoring Radioactivity in Effluents (ANSI/IEEE)

**141**, Recommended Practice for Electrical Power Distribution in Industrial Plants (IEEE Red Book)

**142**, Recommended Practice for Grounding of Industrial and Commercial Power Systems (IEEE Green Book)

**242**, Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems (IEEE Buff Book)

**323**, IEEE Standard for Qualifying Class 1E Equipment for Nuclear Power Generating Stations

**336**, IEEE Standard Installation, Inspection, and Testing Requirements for Power, Instrumentation, and Control Equipment at Nuclear Facilities

**338**, IEEE Standard Criteria for the Periodic Surveillance Testing of Nuclear Power Generating Station Safety Systems

**344**, IEEE Recommended Practice for Seismic Qualification of Class 1E Equipment for Nuclear Power Generating Stations

**379**, IEEE Standard Application of the Single-Failure Criterion to Nuclear Power Generating Station Safety Systems

**384**, IEEE Standard Criteria for Independence of Class 1E Equipment and Circuits

**493**, Recommended Practice for the Design of Reliable Industrial and Commercial Power Systems (IEEE Gold Book)

**1046**, Application Guide for Distributed Digital Control and Monitoring for Power Plants

**1050**, IEEE Guide for Instrumentation Control Equipment Grounding in Generating Stations

**1289**, Guide for the Application of Human Factors Engineering in the Design of Computer-Based Monitoring and Control Displays for Nuclear Power Generating Stations

**ISA** [all formerly ANSI/ISA "S" series]

**5.1**, Instrumentation Symbols and Identification

**5.3**, Graphic Symbols for Distributed Control/Shared Display Instrumentation, Logic and Computer Systems

**67.04**, Setpoints for Nuclear Safety-Related Instrumentation

**84.01**, Application of Safety Instrumented Systems for the Process Industries

**NFPA 70**, National Electrical Code [NEC]

**NFPA 110**, Standard for Emergency and Standby Power Systems; also NFPA 110A

**NRC NUREG-0700**, Guidelines for Control Room Design Reviews

## 9.0 ADDITIONAL REQUIREMENTS FOR SAFETY-RELATED SYSTEMS (PROGRAMMATIC AND FACILITY)

**Note**: Refer to Section 2.0 for the definition of safety-related systems.

A. The codes and standards in Table 8-1 above contain acceptable methods to satisfy the requirements of this section regarding the design of safety-related systems. Alternative methods can be used as long as the requirements of this section are satisfied. Any implementation methods selected shall be justified to ensure an adequate level of safety commensurate with the identified hazards is achieved.[15]

B. The safety functions of instrumentation, control, and alarm systems shall:

1. Provide information on out-of-tolerance conditions/abnormal conditions.
2. Ensure the capability for manual or automatic actuation of safety systems and components.
3. Ensure safety systems have the means to achieve and maintain a fail-safe shutdown condition on demand under normal or abnormal conditions, actuate alarms to reduce public or site-personnel risk, and inform operators of safety actions required and completed (e.g., effluent monitoring components and systems).

C. The design of safety-related instrumentation and control systems shall incorporate sufficient independence, redundancy, diversity, and separation to ensure that all safety-related functions associated with such equipment can be performed under postulated accident conditions identified in the safety analysis. ML-1/safety-class instrumentation, controls, and alarms shall be designed so that failure of non-safety equipment will not prevent the former from performing their safety functions. *Guidance: Safety-significant components should be evaluated for the need for redundancy requirements on a case-by-case basis.*

D. Safety-related instrumentation, control, and alarm systems shall provide the operators sufficient time, information, and control capabilities to perform the following safety functions:

1. Readily determine the status of critical facility parameters to ensure compliance with the limits specified in the Technical Safety Requirements.
2. Initiate and verify completion of manual safety functions and/or verify automatic safety functions were initiated and completed.
3. Determine the status of safety systems required to ensure proper prevention of the accident or mitigation of the consequences of postulated accident conditions and/or to safely shut down the facility.

E. *Guidance: IEEE standards contain design, installation, and testing requirements that should be considered for instrumentation, control, and alarm components without invoking all of the Safety Class 1E requirements. See Table 8-1 for the relevant codes.*

F. Safety-related ventilation system designs shall provide manual or automatic protective control features as needed to prevent or mitigate an uncontrolled release of radioactive and/or hazardous material to the environment and to minimize the spread of contamination within the facility. Also include adequate instrumentation to monitor and assess system performance with the necessary alarms for annunciation of abnormal or unacceptable operation.

G. *Guidance: The preferred method to prevent or mitigate a safety basis event is to provide automatic protective features with appropriate alarms to indicate the approach to actuation of the automatic feature and monitoring devices to provide accurate indication of the sensed parameter value, etc.*

H. *ML levels and SS and SC are discussed in* LIG230-01-02, Graded Approach for Facility Work.

**ENDNOTES:**

Note: In endnotes, EMref refers to a LEM team system for managing hard-to-find reference hardcopies.

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1 LANL LIR 220-03-01.1, "LANL Engineering Manual" is the implementation requirement document for this manual. Refer to Sections 2.0 and 3.0 for statements of the purpose, scope and applicability of the LEM.

2 Replacement value determined using recognized cost estimating procedures and a national material and labor cost database.

3 This is more restrictive than the UBC. Over time this requirement will bring about upgrades to the underlying *I&C* systems in facilities. This percentage was accepted by the TRB per Minutes from the Facility Engineering Manual Technical Review Board meeting on 7/19/00. Fifty percent is also used in Chapter 7; in the 2001 Santa Fe County Urban Wildland Interface Code for use of fire resistant materials in renovations; and for the total luminaire replacement requirement in ASHRAE/IESNA 90.1-2001, Section 4.1.2.2.5.

4 The Facility Engineering Manual (FEM) LIR was retitled LANL Engineering Manual in June 2001 to accommodate programmatic requirements. This was initially to support TA-55 Type A corrective actions relating to design and installation of compression fittings, Teflon, and gloveboxes. Type A Accident Investigation of the March 16, 2000 Plutonium-238 Multiple Intake Event at the Plutonium Facility Los Alamos National Laboratory New Mexico dated 7/2000 at http://tis.eh.doe.gov/oversight/reports/accidents/typea/0003lanl/html/. It was also in response to the January 2001 clarification of 10CFR830 scope to include all activities affecting nuclear safety. Since that time, LANL has committed to addressing DOE O 420.1 concepts in the LEM.

Looking forward: As the name implies, the FEM addressed site-specific LANL requirements applicable to facility systems. Any further extension or adaptation of such LANL-wide requirements to programmatic and experimental installations shall provide flexible and cost-effective approaches that will ensure protection for the environment, the safety of LANL workers, and the protection of the equipment and facilities that they use and occupy. Several different situations seem apparent:

A. Some permanently installed programmatic components (e.g. glove boxes and fume hoods) so closely resemble "facility" equipment that coverage by and compliance with the LEM makes sense from the standpoint of standardized design, construction, operations, and maintenance.

B. Some programmatic installations (e.g. control wiring and components) are at least partially addressed in national standards or DOE publications and addressed by the I&C chapter to varying extents. The POC and technical committee plan to identify these, collect information, and document in the LEM site-specific recommended practices. Requirements would only be added with the concurrence of affected programs.

C. Some programmatic equipment is set-up and used for only a short time or is intentionally destroyed during the experiment. Clearly it is not cost-effective to require that such installations comply with the LEM; however, facilities must be protected, and the safety of workers must be assured. As a starting point, national code and standard requirements for temporary installations could be sought out and applied to such installations.

D. Some very specialized programmatic equipment is clearly far outside the scope of any national standards. Allowing only authorized and qualified technicians using approved procedures described in written SOPs or HCPs to use this equipment controls the risks. The LEM may be applicable up to an identifiable point of demarcation such as a support system boundary.

5 LIR 220-03-01.1, LANL Engineering Manual, empowers the POCs as the Authority Having Jurisdiction for their discipline chapter and related national codes and standards, with rare exceptions.

6 NEC Sections 90.7, 110.2, and 110.3.

7 Part of Appendix G of the University of California/DOE Contract.

8 LIR 220-03-01.1, LANL Engineering Manual.

9 Memo from Lab Counsel to Tobin Oruch, 7/19/01.

10 Pays back in energy savings and supports sustainable design requirements in DOE Order 430.2X, DOE 413.3, and 10CFR435.

11 1997 IAPMO UMC, Section 305.

12 LIR/LIG 402-100-01, Signs, Labels, and Tags; and 1997 IAPMO UPC, Section 601.2.

13 Largely from DOE G 420.1-1, *Nonreactor Nuclear Safety Design Criteria and Explosive Safety Criteria Guide for use with DOE O 420.1 Facility Safety*. Supplemented by SRS Engineering Standards Manual WSRC-TM-95-1, *Introduction Attachment 1, National Codes and Standards for Engineering/Design Tasks Matrix*, 9/99 (these standards are requirements for SRS).

14 ISA 84.01 is a process industry standard for the design, installation, operation, maintenance, start up and periodic functional testing, and management of safety instrumented systems. The standard promotes a risk-informed performance-based methodology for the life cycle management of safety systems. The methodology was applied at Savannah River Site to provide a graded approach to the design of Safety Significant Instrumented Systems (SSISs) in non-reactor nuclear process facilities, based on the unmitigated risk (consequence and frequency) of the safety significant event. Ref. WSRC-MS-2001-00404 Rev 0, *Implementing ISA S84.01 at a Department of Energy Site, Sossman and Suttinger.*

15 From DOE O 420.1.